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ABSTRACT

A course at the University of Minnesota entitled "Perspectives on Computers and Society" explores the social significance of computers. Topics covered include public perceptions of computers, biological and artificial information processing, the economics and technology of hardware, computer networks and software, data banks and the right to privacy, telecommunications, the social responsibility of computer scientist, and the use of computers and quantitative methods in public policy formation. Surveys of student attitudes showed that undergraduates felt the course to be useful, that guest speakers enhanced the credibility and sophistication of the course, that films were not generally useful to the course, and that class discussions were difficult to conduct and unproductive. In addition, more than 75% of the students stated that their attitudes toward computers changed significantly as a result of the course. In general, they gained more respect for the technical utility of computers but also felt more negatively about the overall social impact of these machines. (PB)

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The Impact of a Computers and Society Course on Student Perspectives

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ABSTRACT

This report describes a course entitled "Perspectives on computers and society" and presents findings from student assessments of course impact and attitude change. Almost all of the class members were computer science majors and they entered with rather favorable attitudes toward computerization. By the end of the quarter they were slightly less favorable toward the computer because of its perceived social impact. The desirability of this more balanced perspective is discussed.

KEY WORDS AND PHRASES: computers and society courses, public attitudes, computer literacy, computer science instruction.

INTRODUCTION

Recently it has become fashionable to offer courses which present computers in their broadest context with emphasis on the social and philosophical significance of cybernation. To the authors' knowledge there have been few published accounts of syllabi or evaluation of such courses, a notable exception being the article by Shaw, et.al. (11). It has appeared, however, from numerous inquiries we have received from other colleges and universities, that a broader dissemination of experience is needed. Moreover, if the experience of others is to serve as a positive evolutionary force the literature must contain a broad cross-section of individual courses on which selective pressure may then operate.

A description of syllabus alone, without some evaluation of effectiveness, is obviously of limited value. Accordingly the aim of the present paper is twofold. First we briefly describe a course entitled "Perspectives on Computers and Society" now offered annually in the Computer Science Department of the University of Minnesota. We then report the results of two formal evaluations of the course, one to provide student feedback, the other to scientifically test the degree to which attitudes were changed by the course experience. The latter opportunity arose out of a continuing research program by one of the authors (Anderson), the purpose of which has been to study the attitudes of various social groups toward computerization.

DESCRIPTION OF THE COURSE

A course exploring the social significance of computers was first offered at the University of Minnesota during the spring quarter of 1972. Entitled "Perspectives on Computers and Society" it was conceived and implemented by two of the authors (Franta, Nicholson). Of the fifty registered students, sixty-five percent were computer science majors and a further seventeen percent were from related technical fields (e.g., mathematics and electrical engineering). Grouped by class, sophomores, juniors and seniors comprised fifty-four, twenty-eight, and fourteen percent respectively.

The class met three times weekly for fifty-minute periods. Of the twenty-eight sessions, six involved film showings, twelve featured guest lecturers and the remaining ten were handled by the faculty in charge. Below is a roughly chronological list of topics discussed.

1. Computers as perceived by the public (e.g., the image fostered by the press).
2. Biological and artificial information processing (Von Neumann (9), Arbib (1); the limits of computability (Minsky (6), Trakhtenbrot (9)).
3. The economics and technology of the hardware industry (Martin-Norman (5), Scientific American (10)).
4. Computer networks, software systems and the technology of information security (Hoffman (3), Martin-Norman (5)).
5. Case study of a proposed data bank for criminal justice information (Patton (8)).
6. Vieving and discussion of the NET film, The Right to Privacy (7).
7. The methodology of technological forecasting; some case studies (Joseph (4)).
8. A view of artificial intelligence with emphasis on simple game playing and semantic interpretation of English Text.
9. A brief introduction to tele-

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communications technology (Martin-Norman (5)).

10. Automata as portrayed in literature (Baer (2)).

11. Social responsibility of computer scientists (Weizenbaum (12)).

12. The use of computers and the quantitative method in public policy formulation.

Evaluation was based on an in-class final examination and a term paper of the student's choice. The final required an essay on one of four (non-technical) topics, each of which extended the class discussions. A carefully selected bibliography of over one hundred items was provided to aid the initiation of term paper literature searches.

On the last day of class the students were given an opportunity to evaluate all aspects of the course. To guide the evaluation, we prepared an extensive questionnaire which nevertheless provided ample space for self expression. Of the forty-seven responding, all judged the course useful. On balance seventy-eight percent felt that their attitude toward computerization had been significantly changed. This remark is discussed in a later section and summarized in Table 2.

COMPUTERIZATION ATTITUDE SURVEYS

During the first and last class periods, the students were asked to respond to two opinion surveys designed by one of the authors (Anderson) during the course of his research into public attitudes toward computerization. Each survey was subdivided into four sections, A through D, with only section A differing between the two administrations. In the first survey, section A was used to obtain: (i) a standard personal profile (e.g., age, sex, parent's schooling, etc.) (ii) an indication of ideological bias and philosophical attitude (e.g., "What is your level of agreement with (a) liberals (b) business" etc. and "Rate according to personal importance: (a) equality (b) scientific knowledge" etc.) and (iii) the degree of the respondent's involvement with computers and his reaction to certain popularly held attitudes toward automation (e.g., "Do you understand enough about computers to write programs for them?" and "Some say that the business-customer relationship has been rendered too impersonal by the computers. Are you inclined to agree or disagree?". The responses to these items have been used primarily in the comparison of social subgroups (e.g., computer science students versus social psychology majors) and will not be elaborated on here. In the second survey, section A consisted of but two questions the responses to which appear below as Table 2.

Section B consisted of fifty-three single line statements, a typical example being: "Computers tend to dehumanize people." The respondent indicated his degree of agreement or disagreement on an integer scale of 1-5.

Section C employed seven computer related cartoons each depicting some human response to automation (e.g., a man holding aloft a picket in the image of a punched card). The respondent was asked to indicate his degree of identification (scale 1-5) with the human in each picture.

Finally, Section D listed twenty-one antonym pairs each of which might define the poles of an attitude toward computers. By circling an integer from 1 to 5 the respondent indicated his position between the two poles. For example, "Computers in general tend to be: Simple 1 2 3 4 5 Complex."

Further examples of items from sections B and D are reproduced in Table 1.

ANALYSIS OF THE ATTITUDE SURVEYS

Approximately forty-five students responded fully to both surveys. The quantification of attitudes in sections B, C, and D (i.e., the integer scale 1-5) permitted the compilation of several statistical measures the results of which are given in Table 1.* For presentation we have retained only those responses which seemed to us to be most interesting and significant. With each survey item we have tabulated the sample mean and standard deviation for the two surveys. Also tabulated is the algebraic difference between the sample means and a quantity labeled '2-tail probability'. The latter is computed from the student's t-distribution appropriate to that "null hypothesis" which asserts the equality of the two response means in the item being analyzed. A value for "t", say $\bar{t}$, is computed from the samples and from this is calculated the 2-tail probability, viz. Prob $\{ |t| \geq |\bar{t}| \}$. Small values of the latter suggest that the means were in fact not equal thus providing some confidence in the hypothesis that genuine attitude change has taken place during the course. (The normality assumptions underlying the "t-test" certainly do not apply to our samples, thus one should not attach undue quantitative significance to the probabilities. Nevertheless they are useful qualitative indicators.)

Finally, for comparison purposes the t values for a control group (see the footnote accompanying Table 1) are also included.

REMARKS

a) The survey results in TABLE 1 have been so arranged that the first four responses reflect a more positive attitude toward computers following the course,

* Reproduction difficulties prevented the inclusion of cartoon items.

while the remaining eleven indicate a negative attitude change. Of the untabulated items, twenty-seven showed an "anti-computer" shift while only six were more positive. In most cases the changes were individually small. However, if one assumes a priori that positive changes are as likely as negative ones then the strong predominance of the latter is quite improbable and so suggests a true effect.

b) Though we have focused on attitude change, the absolute level of response is also significant. Examining this we see a predominantly favourable attitude toward computers. Indeed all fifteen of the tabulated items revealed initial pro-computer sentiments and only items (9) (i.e., "Computers pose a threat to privacy") tipped slightly negative in the final survey. This bias is not suprising given the composition of the class. Unfortunately there may be an "end effect" inherent in our response scale. If, for example, a mean value is near 1 a further change (toward 1) is virtually precluded. Thus, if all initial responses are biased toward either end of the scale there may be a systematic tendency for changes to take place toward the more distant end. For small shifts this "end effect" will likely be slight; moreover, there are several items (e.g., (1), (2), (3)) where a positive attitude was further polarized.

c) The reader may have noticed an inconsistency between the response to question (2), in Table 2 and the claim made earlier that seventy-eight percent of the class judged that their overall attitude toward computers had changed. The latter figure was derived from our course evaluation questionnaire in which the students were asked to: "Describe, in your own words, how your attitude toward computers has been affected by the course experience." The free format response to this question almost surely provides a more reliable index of attitude change, a claim which is further supported when one cross-tabulates the answers to (a) and (b). Of the twenty-two who claimed no change at all in "their ideas and feelings about computerization," six said they were more concerned about "the future impact of computers on society." This startling inconsistency apparently derives from differing emphasis in the two questions. To answer (a) required a summation of attitudes, pro and con, while (b) focused on but one component, social impact.

CONCLUSIONS

An adequate assessment of the course itself is of necessity a blend of our subjective impressions and the more structured student evaluations. Thus judged, the following seemed significant.

a) Students expressed a strong antipathy toward the formal material on automata, cybernetics and the limits of algorithms. Though the presentation was elementary, the philosophical significance was clearly not appreciated.

b) The inclusion of guest speakers is a virtual necessity if a course such as this is to have credibility and sophistication. Some discontinuity in presentation is an undesirable side effect which is difficult to avoid.

c) Film showings are a tempting adjunct but it is rare to find one appropriate for a technically savvy, college-level audience. A notable exception is the NET film, the Right to Privacy (7) which, more than any other single agent, appeared to significantly alter class attitudes.

d) Class discussion was difficult to promote as it inevitably is with fifty students. However, this reticence persists even in small groups unless the potential discussants are first forced to think seriously about the issue. Apparently the only way to ensure the latter is to require from everyone a short essay on each topic just before it is discussed. Though often considered a tactic not appropriate for mature students, such an assigned workload is the norm in quantitative courses where, for some reason, it is rarely questioned.

The following remarks are derived from an analysis of the attitude surveys.

Judged on the basis of the responses in sections B, C, and D, the net effect of the course experience was to significantly alter the mean class attitude toward computerization in general. The change may be resolved along two distinct axes. Perceived in isolation as an instrument of technology the computer came to be viewed in an even more favourable light than initially (see the responses to items (1)-(4)). On the other hand, when perceived primarily as a social force, the final class attitude was clearly more negative than it initially had been. (See items (5)-(15)). At least two explanations come to mind, the most obvious appealing to an inevitable bias in the presentations. This effect is not easily ruled out but as instructors we made a conscious effort to present balanced viewpoints both in lectures and readings. The likelihood of presentation bias is further mitigated by the paradoxical response to the query on overall attitude change. There, only six of forty-three reported more negative feelings while more than one third claimed a more positive attitude toward computerization. In the light of this, if one re-examines the negative responses on the second survey, all changes are toward the middle of the scale, indicating a tendency toward mixed feelings ("I neither agree nor disagree") which, in most instances, is a more appropriate reaction to the question. This interpretation supports the hypothesis that the primary course effect was to leave the students explicitly aware of the "Jekyll and Hyde" nature of so complex a technology. Indeed, it seems characteristic of well-informed social opinion that it refuses to polarize strongly toward any

particular attitude, adopting instead a middle ground, which, paradoxically, is also the position of the ignoramous.

On the purely technical side, the further favourable polarization is not unexpected, for here the issue is essentially one-dimensional. In many ways the computer, as instrument, becomes the more remarkable in proportion to one's knowledge of it. Several talks focused on spectacular developments now and in the offing (e.g., super miniature hardware, semantic interpretation of language, computer networks, etc.) with the effect that the technical promise appeared even greater than most students had realized.

Perhaps the primary goal of education in other than pure "content" areas is to provide some degree of that ephemeral quantity, well-informed opinion. Colleges of science and engineering have always been skeptical of this goal because it has lacked an objective measure of attainment. This deficiency is likely to persist to an extent, however, for it is surely fallacious to assume that the essence of all things can eventually be distilled from a set of "objectively" calculated numerical measures. Nevertheless, a crude metrization is possible and may even provide a novel insight here and there, particularly if similar measurements are performed in longitude and broad cross section. At Minnesota, we will continue to survey our class each time the course is given and we would urge others, presenting analogous material, to do likewise. From such a combined effort some useful conclusions of universal validity may emerge.

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Table 1

Computerization Attitudes Change During Computers and Society Course, N=45

Statements	Means		Diff. in Means	Standard Deviations		P (2-tail Probability)	
	Pre-test (t_1)	Post-test (t_2)		t_1	t_2	Computer Class	Control*** Group
1. Computers free individuals for more creative kinds of work.*	1.93	1.75	.18	1.1	.8	.30	.25
2. Computers help us to be more rational.	2.78	2.51	.27	1.3	1.0	.13	.12
3. Computers are exciting to work with because they are so powerful.	2.51	2.18	.33	1.2	.8	.05	.20
4. Computers are helping to raise the standard of living for the American people.	2.27	2.22	.05	1.0	.8	.63	.88
5. Computers are preventing the average citizen from having direct contact with the government and private industry.	3.82	3.2	.62	1.1	.9	.00	.5
6. People lose a sense of responsibility when they rely on a computer.	4.11	3.44	.66	.9	1.1	.00	.7
7. Computerization tends to dehumanize people.	3.63	3.16	.47	1.2	1.1	.01	.4
8. Technology has made life too complicated.	3.56	3.16	.40	1.1	1.1	.04	.45
9. Computers represent a real threat to people's privacy.	3.11	2.58	.53	1.3	1.2	.01	.04
10. Computers will ultimately produce more disadvantages than advantages.	4.2	4.0	.2	.9	.9	.08	.34
11. Good-Bad**	1.68	2.04	-.36	.78	.9	.02	.32
12. Hindering-Helping	4.4	4.2	.2	.7	.7	.07	.18
13. Disgusting-Pleasing	3.8	3.5	.3	.8	.7	.01	.99
14. Personal-Impersonal	3.5	3.8	-.3	1.0	.9	.02	.18
15. Better World-Worse World	1.86	2.0	-.14	.9	.9	.22	.80

*Items (1) through (10) are selected from section B. Observe that the response range is graduated as follows: 1. Agree very much 2. Agree a little 3. Neither agree nor disagree 4. Disagree a little 5. Disagree very much

**Items (11) through (15) are selected from section D, the adjective pairs denoting polar attitudes toward computers in general. A mean response near 1 indicates predominant agreement with the first adjective of the pair.

***The control group consists of 135 students taking introductory social psychology courses at the University of Minnesota during the same quarter. Although these students tend to be social science and humanities majors and hence differently oriented than the Computer Science course students, the responses constitute a useful "control group" because the questionnaires were identical and were also administered the first and last days of the quarter. The P values of the control group reveal that the control group changes can all be interpreted as due to chance variation: only one difference is below the 0.10 probability level. On the other hand, the computers and society class had 9 out of 15 item differences that were below the .10 level, and hence potentially resulting from some real change in attitude or response pattern.

Table 2

Below is a simple tabulation of the section A response on the second survey

(a) Did your ideas and feelings about computerization change as a result of the course?

Response	Number	% of Total
1. Yes, more positive toward computerization	15	34.9
2. No change at all	22	51.2
3. Yes, more negative toward computerization	6	14

(b) Are you more or less concerned about the future impact of computers on society?

Response	Number	% of Total
1. Less concerned	0	0
2. About the same as before	20	46.5
3. More concerned	23	53.5